IT CORPORATION

NICOR MERCURY RESTORATION PROGRAM

QUALITY ASSURANCE REPORT "NOT INVOLVED" RESIDENCES JANUARY, 2001

Patricia A. Gallery
IT Corporate Quality Assurance Officer

January 12, 2001
IT Project 990534

EXECUTIVE SUMMARY

In accordance with the work plan approved by the Mercury Task Force, Nicor performed visual inspections of residences to determine if mercury regulators were present or had potentially been present inside the residences at some past time. IT Corporation (IT) prepared a Quality Assurance/Quality Control Plan to be used in support of Nicor's Mercury Restoration Program. This Plan required that an IT Quality Assurance Supervisors re-inspect one "not involved" residence for each Nicor inspector per day. This approach measured how the Nicor inspector performed against the training criteria, but not whether the residence was correctly classified as "involved" or "not involved". As a result, IT proposed an alternative quality assurance assessment approach.

This alternative approach, also approved by the Task Force, proposed instrument inspections be conducted on a geographically stratified, random sample of 7,382 "not involved" residences. The purpose of the visual inspections was to separate residences that had a low probability of being impacted by mercury from those residences that had a higher probability of being impacted by mercury, thus requiring further investigation. If the visual inspections were effective in providing this separation, the probability of residences impacted by mercury (as measured by mercury vapor levels) would be significantly lower for the "not involved" residences as compared to the "involved" residences. In fact, none of these residences were classified as "instrument detects" by this instrument screening, though two of the residences had detectable levels of mercury vapors not due to Nicor equipment.

IT performed a statistical comparison which indicated that the probability of "instrument detects" in the "not involved" population was significantly and statistically lower than the probability of "instrument detects" in the "involved" population. Therefore, the criteria used by the Nicor inspectors correctly segregated "not involved" residences.

ALTERNATIVE QUALITY ASSURANCE FOR THE "NOT INVOLVED" RESIDENCES

In accordance with the work plan approved by the Mercury Task Force, Nicor performed visual inspections of residences to determine if mercury regulators were present or had potentially been present inside the residences at some past time. IT Corporation (IT) prepared a Quality Assurance/Quality Control Plan to be used in support of Nicor's Mercury Restoration Program. IT Quality Assurance Supervisors re-inspected one "not involved" residence for each Nicor inspector per day. This approach measured how the Nicor inspector performed against the training criteria, not whether the residence was correctly classified as "involved" or "not involved". Measurement of performance against the training criteria would negate the experience and institutional knowledge of the Nicor inspectors, overestimating the "true" error rate for the classification of residences.

IT recommended that an alternative quality assurance assessment be used. The purpose of the visual inspections was to separate residences that had a low probability of being impacted by mercury from those residences that had a higher probability of being impacted by mercury, thus requiring further investigation. If the visual inspections were effective in providing this separation, the percentage of homes impacted by mercury (as measured by mercury vapor levels) would be significantly lower for the "not involved" residences as compared to the "involved" residences. Also, a "true" error for the visual inspection would be that a residence with detectable mercury vapor levels would be considered "not involved", regardless of how it would be classified under Nicor's training criteria. The only way to detect this "true" error is with instrument screening.

INSTRUMENT SCREENING OF "NOT INVOLVED" RESIDENCES

The implementation of the alternative quality assurance assessment recommended by IT was approved by the Mercury Task Force in mid-December. A geographically stratified, random sample of "not involved" residences were subjected to instrument screening. The geographic stratification of the selected residences was done to mirror the geographic distribution of the "not involved" residence population. The Nicor instrument screening personnel were not informed of the purpose of the instrument screening and were merely provided the appropriate addresses. A

total of 7,382 "not involved" residences were instrument screened; this number was in excess of the estimated required sample size of approximately 6,100. 7,380 of these residences were classified as "instrument clear" by this instrument screening. Two residences did have detectable levels of mercury vapors, though not attributable to Nicor gas regulation equipment. One residence had been converted to a dental office, while the other had a mercury-containing pressure seal on a gas-fired boiler. Inspection of the location and piping of the gas service to these residences confirmed that mercury regulators were never present inside these residences.

STATISTICAL EVALUATION OF THE INSTRUMENT SCREENING RESULTS

The data from the instrument screening discussed above was used to compare the probabilities that an instrument inspection of a randomly selected residence would result in an instrument detect (ID), conditional on whether or not the residence was deemed "not involved" (NI). The purpose of this comparison was to demonstrate that the probability of an instrument detect found at a "not involved" residence should be less than the probability of an instrument detect at an "involved" residence [$\Pr(\text{ID}|\text{NI}) < \Pr(\text{ID}|\overline{\text{NI}})$]. From the instrument inspections conducted to date by Nicor, the probability of an instrument detect for an "involved residence [$\Pr(\text{ID}|\overline{\text{NI}})$] is 1,013/115,000 or about 0.88%. The instrument screening of the "not involved" residences indicate that Pr (ID| NI) is 0/7,382.

Let $p_1 = \Pr(\text{ID}|\overline{\text{NI}})$ and $p_2 = \Pr(\text{ID}|\text{NI})$. We tested the hypotheses:

$H_0 : p_1 \le p_2$ versus
$H_1 : p_1 > p_2$

using Fisher's Exact Test (Lehman, E.L. (1986). *Testing Statistical Hypotheses*. Second Edition. John Wiley & Sons. New York. pp. 154, 155). The computations are detailed in Appendix A. The p-value for the test statistic is much less than 10^{-9}. Therefore, we reject H_0 and accept H_1, where the probability of an instrument detect in a "not involved" residence is less than the probability of an instrument detect in an "involved" residence.

Also, the 95% upper confidence limit (UCL) for p_2 is 0.04%; whereas, the 95% lower confidence limit (LCL) for p_1 is 0.75%. The fact that there is no overlap between the UCL for p_2 and the LCL for p_1 indicates with greater than 95% confidence that the probability of an instrument detect found at a "not involved" residence is statistically less than the probability of an instrument detect at an "involved" residence $\Pr(\mathrm{ID}|\mathrm{NI}) < \Pr(\mathrm{ID}|\overline{\mathrm{NI}})$.

A significantly and statistically lower probability of "instrument detects" in the "not involved" population would indicate that the "true" error rate for the determination of "not involved" is low.

CONCLUSION

The evaluation of the data generated from the instrument screening of the geographically stratified, random sample of 7,382 "not involved" residences indicated a significantly and statistically lower probability of "instrument detects" in the "not involved" population. From this evaluation, IT concludes that the "true" error rate for the determination of "not involved" is low. Therefore, the criteria used by the Nicor inspectors correctly segregated residences with a low probability of being impacted by mercury.

Appendix A – Statistical Evaluation of Probabilities

ID Rate Comparison by Involved-NI Status

Quantity	Symbol	Value	Approx. 95% LCL	Approx. 95% UCL
Num NI checked	Nn	7,382		
Num NI found ID	Xn	0		
Rate of NI ID	Est. pn	0.00%		0.04%
Num Involved checked	Ni	126,292		
Num Involved found ID	Xi	1,013		
Num Involved found IC	Ni - Xi	125,279		
Rate of Involved ID	Est. pi	0.80%	0.75%	

Hypotheses

H0: pi <= pn

H1: pi > pn

Hypergeometric Parameters			
Symbol	Value	Comment	Analogy
M	1,013	total # of ID	# Red balls in urn
N	132,661	total # of IC	# Black balls in urn
k	7,382	sample size	Sample size
x	0	# of ID in sample	# Red balls in sample

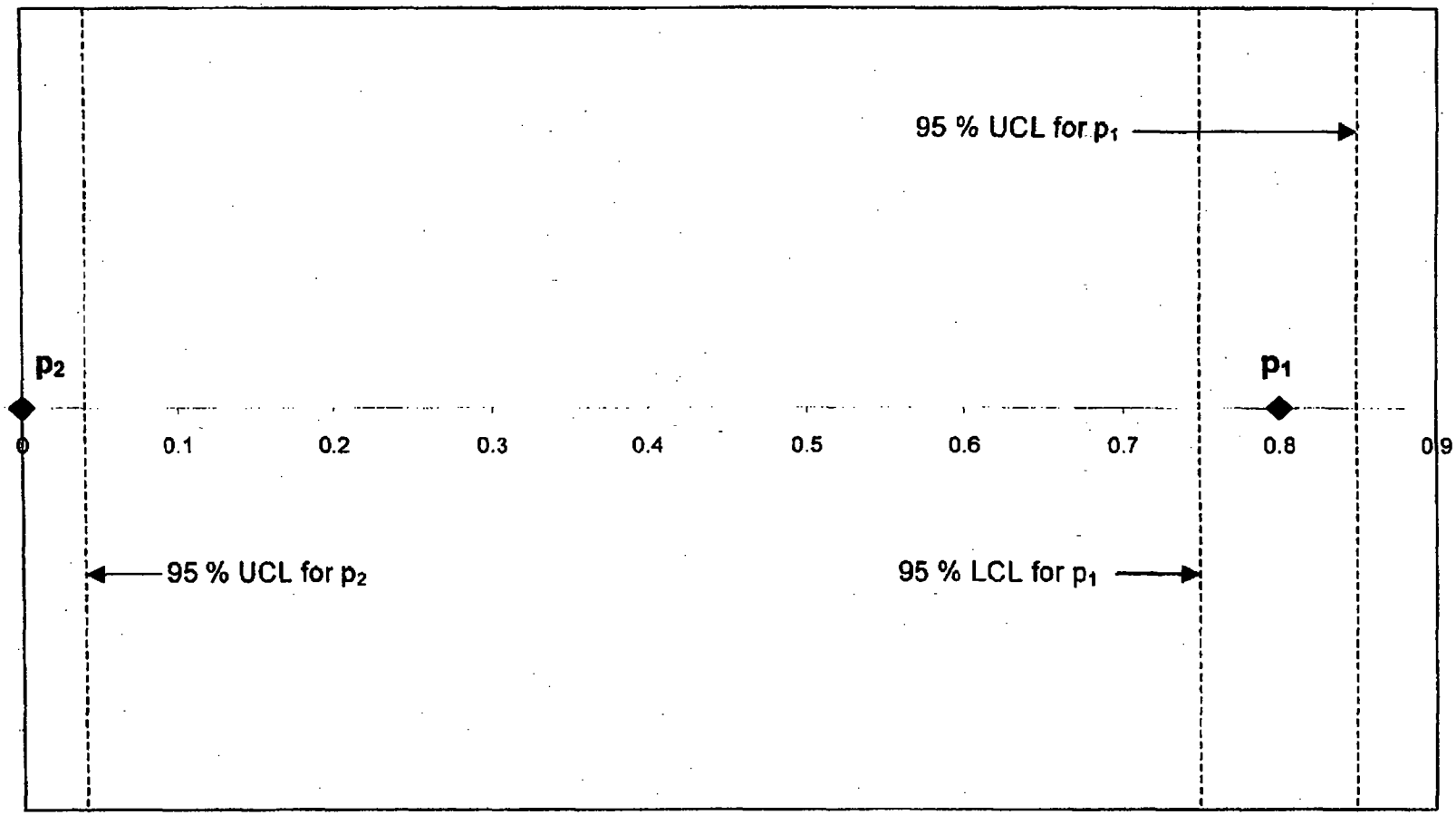
Calculations

Conditional random variable (Xn | Xn + Xi = M) has Hypergeometric(x; M, M + N, k) distribution.

Excel HYPGEOMDIST computation	#NUM!		
E(Xn | Xn + Xi = 1013) =	55.94181		
Var(Xn | Xn + Xi = 1013) =	52.45236		
P(Xn <= 0 | Xn + Xi = 1013) =	5.66E-15	*Normal Approximation*	**===> We reject H0!**
P(Xn <= 0 | Xn + Xi = 1013) =	8.13E-26	*S-PLUS phyper() function*	**===> We reject H0!**

N0021124

Instrument Detect Probabilities
95% Confidence Limits



N0021125

MAYER, BROWN & PLATT

190 SOUTH LA SALLE STREET

CHICAGO, ILLINOIS 60603-3441

RICHARD F. BULGER
DIRECT DIAL (312) 701-7318
DIRECT FAX (312) 706-8789
rbulger@mayerbrown.com

MAIN TELEPHONE
312-782-0600
MAIN FAX
312-701-7711

February 15, 2001

Mr. Brad Stimple
U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, IL 60604

Dear Brad:

Attached please find the IT Corporation Quality Assurance Report (N0021118 - N0021125) which you requested with respect to "not involved" residences. Please feel free to call if you have any questions regarding this report.

Thank you.

Sincerely,

Richard F. Bulger

Cc: Rebecca Burlingham (w/o attachment)
John Berghoff (w/o attachment)
Mark Ter Molen (w/o attachment)
Dick Tappan (w/o attachment)

MAYER, BROWN & PLATT

190 SOUTH LA SALLE STREET

CHICAGO, ILLINOIS 60603-3441

MAIN TELEPHONE
312-782-0600
MAIN FAX
312-701-7711

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